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THE CYTOLOGY OF THE EXUDATE IN THE EARLY STAGES OF EXPERIMENTAL PNEUMONIA*

PLATES 15 AND 16

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On examination of sections from the consolidated lungs of pneumonia patients dying in the first few days of the disease it is readily appreciated that the cellular characteristics of the exudate in the early stages are not the same as in the almost exclusively polymorphonuclear exudate of the later stages. The early exudate is predominantly mononuclear in character, and is to be differentiated from that of the very late stages when again mononuclear cells are frequently numerous. In the later stages the mononuclear cells present are plasma cells and desquamated alveolar epithelial cells. The mononuclears seen in the early exudate are not, however, so readily classified. Several distinct types must be recognized (Fig. 1), and each type is constant in its occurrence. It has been our aim to identify some of these cells in the pneumonic processes experimentally induced in rabbits, and in the processes early in 3 cases of human pneumonia.

The pneumonic process was induced in each rabbit by intrabronchial injection of 8 c.c. of an 18-hour neutral-broth culture of the organism after the method of Meltzer and Lamar.[1] The organisms injected were strains from Pneumococcus Group I and Group IV, an attenuated strain of pneumococcus of undetermined group, a hemolytic streptococcus, and a streptococcus isolated from the mouth of a normal individual. The exudate in reaction to intrabronchial injection of 33% egg yolk in neutral broth was also studied.

The lesions were examined at periods varying from 8 to 36 hours. In some cases the gross distribution of the process was fairly regular, embracing an entire lobe or all the lobes of one side, tho it was never entirely homogeneous as in human lobar pneumonia; in other cases the distribution was patchy. The even distribution was commonly encountered after pneumococcus injection, and the patchy after the injection of a streptococcus, but this was not constant. In a number of the rabbits the alveolar walls were infiltrated, the infiltrating cells being of the same character as those in the exudate (Fig. 1). The cytology

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[1] Jour. Exper. Med., 1912, 15, p. 133.

of the early exudates in the three human cases of pneumococcal pneumonia, coming to autopsy on the 3rd, 4th, and 5th days respectively, was the same as that of the experimental pneumonia in rabbits (Fig. 4).

Except for slight variations in the relative proportions in which the cells were present, depending to some extent on the organisms, but more particularly on the age of the exudate, the cytology was the same in all the preparations. Typical small lymphocytes of the blood were always present in small numbers and were easily identified. Even in the very early exudate some polymorphonuclears were constantly seen, perhaps only one to an alveolus in some places, but to the exclusion of all other types in other alveoli in the same section. A few very large mononuclear cells also were frequently encountered which, by reason of their morphology and staining properties, could be definitely classified as epithelial cells in various stages of degeneration. In addition to these there were other mononuclears which were the predominating mononuclear cells, and except in those alveoli where the polymorphonuclears outnumbered them, they were the predominating cells of the exudate. These cells, always much larger than the polymorphonuclears, yet smaller than the epithelial cells, fell into 2 groups, depending on whether or not they contained an oxydase ferment as demonstrated by the indophenolblue reaction[2] (Fig. 2). Other differential criteria were indefinite except that those containing an oxydase ferment commonly had a slightly or markedly indented nucleus with only a fair amount of chromatin and abundant homogeneous protoplasm that occasionally showed faintly a fine granulation, whereas those cells that did not contain an oxydase ferment had, as a rule, a round or oval nucleus often showing one or two flat surfaces and sometimes staining deeply, and abundant homogeneous protoplasm that never showed evidence of granulation. In form the typical cells of the first group strongly suggested the so-called transitional cells of the blood and were so considered by Pratt[3] in 1900. Their content of oxydase ferment makes this seem likely if myelocytes are not considered. Both myelocytes and so-called transitional cells give the oxydase reaction, and as Naegeli has pointed out[4] the differentiation between them in tissue sections is sometimes difficult. Certainly a few cells resembling myelocytes were to be seen. Myelocytes probably were present in small numbers, but, altho they must be considered, the morphology of most of the cells under discussion was not that of myelocytes and it seems quite certain that they belonged to the so-called transitional-cell group. The other cells, those that did not give the oxydase reaction, were probably lymphoid in origin, and many of them resembled very much the pictures of polyblasts appearing in Maximow's articles.[5] They were not reticulo-endothelial cells, for tho such cells, vitally staining by carmin, are occasionally seen normally in the alveolar walls, in pneumonia in rabbits heavily stained by carmin these carmin cells were not seen taking part in the formation of the exudate. That they are closely related to the blood elements is further borne out by the fact that in pneumonia induced in rabbits poisoned by benzol,[6] whereby the leukocytes and leukopoietic tissue were destroyed, cells were seen in the exudate (Fig. 3). No plasma cells were seen in any of these preparations.

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[2] Evans: Proc. New York Path. Soc., 1915, 15, p. 143.

[3] Johns Hopkins Hosp. Rep., 1900, 9, p. 265.

[4] Blutkrankheiten und Blutdiagnostic. 1912, p. 193.

CONCLUSION

In the early exudate of pneumonia, altho many polymorphonuclears may be present, in many alveoli the cytology of the exudate is predominantly mononuclear in character. The mononuclear cells may be classified as follows: (1) a few typical small lymphocytes, (2) a few desquamated alveolar-wall epithelial cells, (3) relatively many oxydase-containing large mononuclears of the blood, belonging to the so-called transitional-cell group of Naegeli, and (4) almost as many non-xydase-containing large mononuclears of the blood or closely related forms.

EXPLANATION OF PLATES

A = small lymphocytes.
B = polymorphonuclears.
C = desquamated epithelial cells.
D = oxydase-containing large mononuclears.
E = non-oxydase-containing large mononuclears.

FIG. 1. Section of consolidated rabbit lung in which pneumonia has been induced by intrabronchial injection of Streptococcus hemolyticus. Animal killed 14 hours after inoculation. The cells infiltrating the alveolar walls are essentially the same as those in the alveolus.

FIG. 2. The indophenolblue reaction on a section of consolidated rabbit lung after pneumococcus injection. The nuclei are counterstained by 5% aqueous pyronin.

FIG. 3. Section of consolidated rabbit lung in which pneumococcal pneumonia has been induced after destruction of the leukopoietic tissue by administration of benzol.

FIG. 4. Section of consolidated human lung from a pneumococcal pneumonia, patient dying on the third day of the disease. This also represents accurately the condition in induced pneumococcal pneumonia in rabbits.

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[5] Beitr. z. path. Anat. u. z. allg. Path., 1903, 34, p. 153; 1904, 35, p. 93; 1905, 38, p. 301.

[6] Selling: Ibid., 1911, 51, p. 576.

PLATE 1

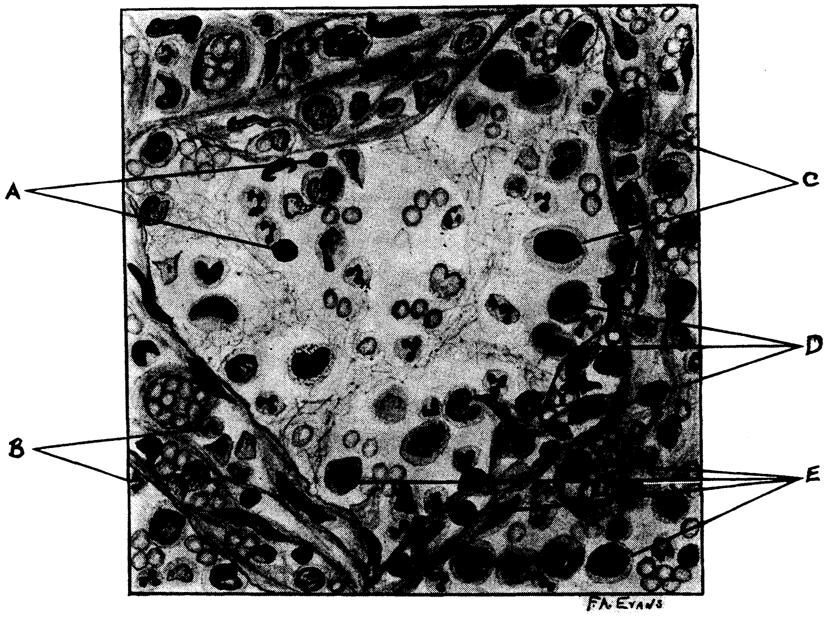

Figure 1

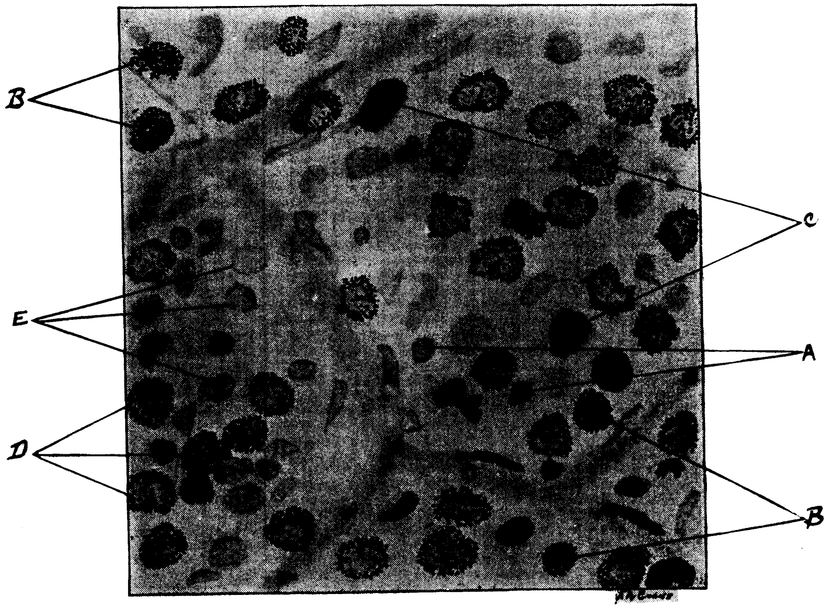

Figure 2

PLATE 2

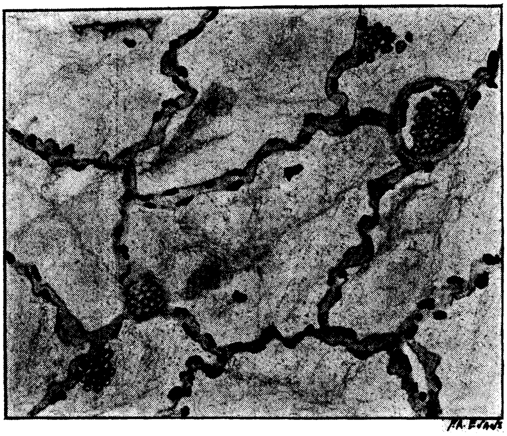

Figure 3

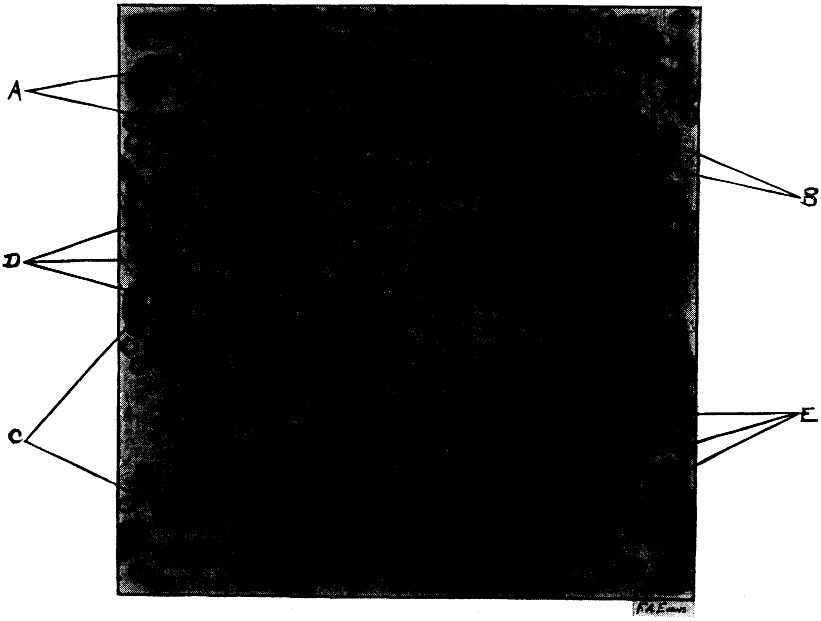

Figure 4